



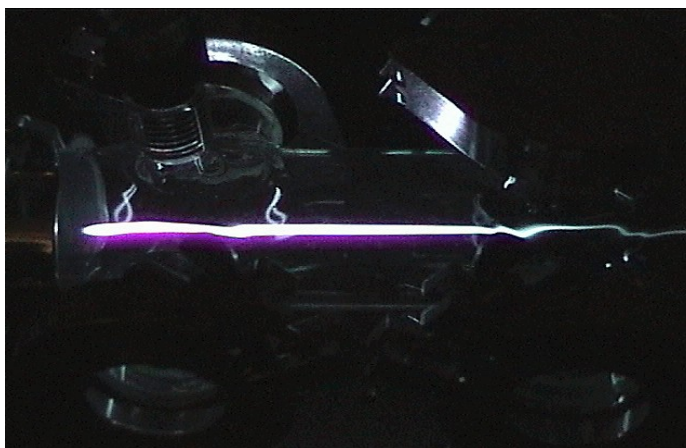
Air Plasma Ramparts MURI Ohio State University



Started 1 May 1997

Web URL: <http://rclsgi.eng.ohio-state.edu/~lempert/netl/>

October 1999



Optically pumped atmospheric air plasma

Scientific/technical approaches

- External ionization: high efficiency, suppressing plasma instabilities
- Optical pumping: production of molecular metastables to reduce the electron loss rates (recombination and attachment), and to produce additional ionization

MURI Objective

- To discover physical mechanisms for significantly reducing power needed for cold air plasma generation
- To develop a method to make practical the use of such air plasmas for the protection of future DoD systems & personnel

Accomplishments

- Efficient generation of optically pumped, stable, cold, atmospheric air plasma
- Electron removal rate reduction (up to 2 orders of magnitude) in these plasmas
- Guiding and control of a welding arc with an energy-efficient CO infrared laser
- A state-of-the-art predictive model

09/11/16



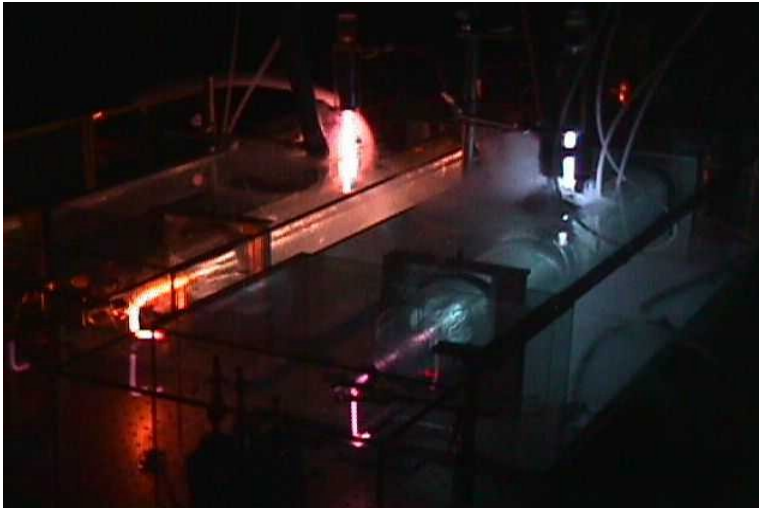
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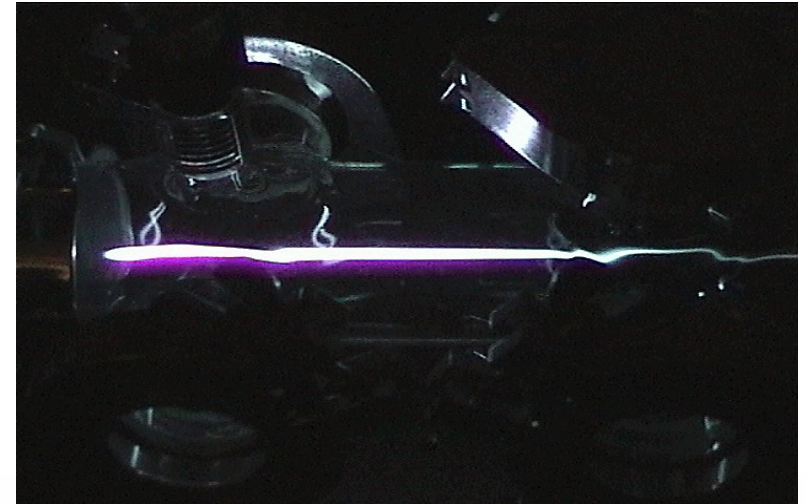
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**Dual CO laser
system**



**Optically pumped atmospheric
air plasma**

Scientific/technical approaches (1)

- Optical pumping: associative ionization in collisions of highly excited metastables (no electric field applied)

Accomplishments (1)

- Generation of optically pumped, stable, cold, atmospheric air plasma using energy-efficient CO lasers

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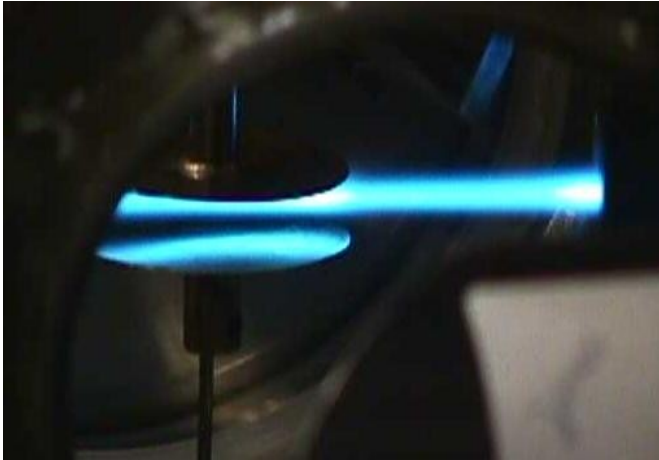
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Optically pumped plasma
between two DC/RF probe
electrodes

Scientific/technical approaches (2)

- Optical pumping: production of molecular metastables to reduce the electron loss rates (recombination and attachment)
- DC/RF probe: independent measurements of electron production rate and electron density

MURI Objective

- To discover physical mechanisms for significantly reducing power needed for cold air plasma generation
- To develop a method to make practical the use of such air plasmas for the protection of future DoD systems & personnel

Accomplishments (2)

- Electron removal rate reduction (up to 2 orders of magnitude) demonstrated in optically pumped plasmas

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**S-shaped welding arc
discharge
following the CO laser beam
path**

Scientific/technical approaches (3)

- Optical pumping: associative ionization in collisions of highly excited metastables (no electric field applied)

MURI Objective

- To discover physical mechanisms for significantly reducing power needed for cold air plasma generation
- To develop a method to make practical the use of such air plasmas for the protection of future DoD systems & personnel

Accomplishments (3)

- Guiding and control of a welding arc with an energy-efficient CO infrared laser

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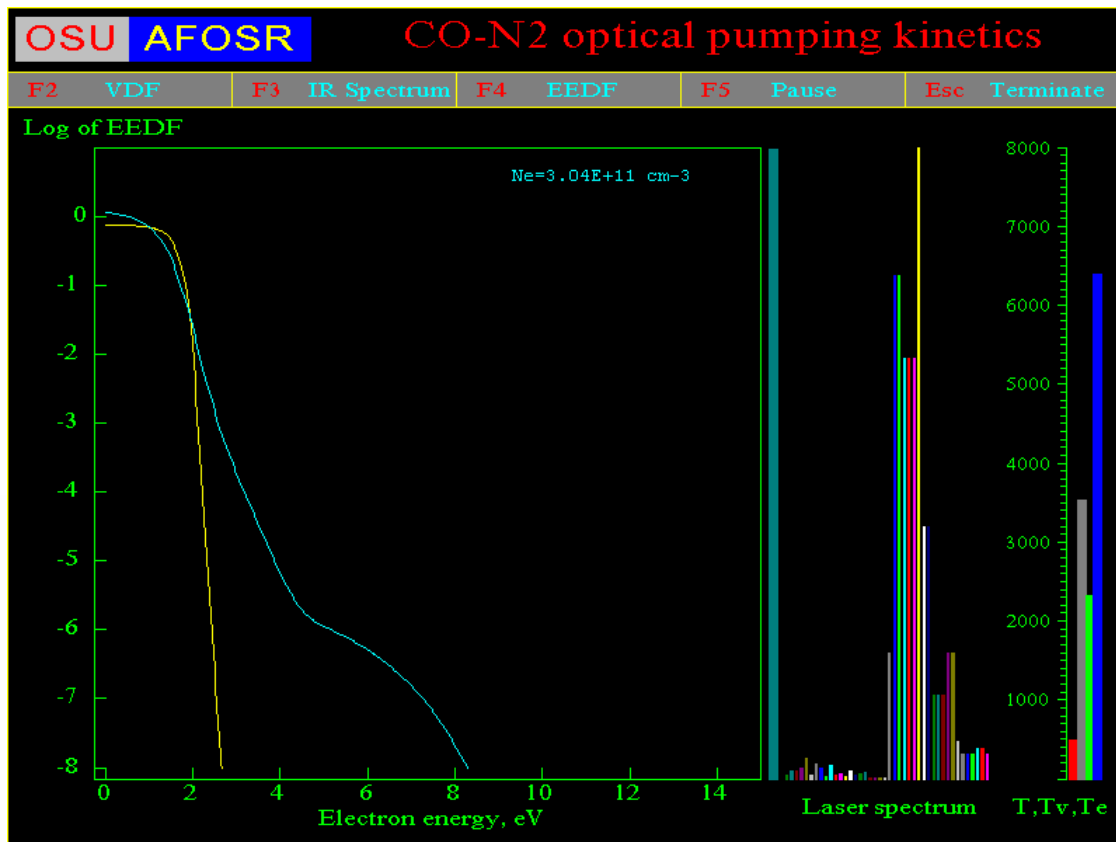
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Electron distribution function in optically pumped plasma

Scientific/technical approaches

- Plasma modeling: state-specific kinetics of molecular metastables, detailed kinetics of plasma electrons

MURI Objective

- To discover physical mechanisms for significantly reducing power needed for cold air plasma generation
- To develop a method to make practical the use of such air plasmas for the protection of future DoD systems & personnel

Accomplishments (4)

- A state-of-the-art predictive model of atmospheric air plasmas

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